Improving CD Sound

Most so-called CD improvement gizmos and tweaks don't really work. We have found two that are happy exceptions. They really do deliver better sound from all your CDs.

The Audio Desk CD Sound Improver from Germany is a miniature turntable that you use once (per CD) to mechanically trim the CD's uneven edge. The Furutech RD-1 Disc Demagnetizer from Japan is a specially designed demagnetizer that you can use repeatedly on a CD, to periodically eliminate any stray magnetism it might have accumulated while spinning during playback. Both units have been imported into the USA by Ultra Systems (800-724-3305).

We've conducted A-B, before vs. after comparisons of many types of CD improvement devices and techniques. Most do indeed make a sonic difference. But the problem is that different sound does not necessarily mean better sound. With many of these other devices we don't find that the sonic difference is actually an improvement, and in some cases there are some sonic benefits but also some sonic drawbacks. Thus, the sonic change they wreak is not wholly for the better. Often, the sound gets softer and smoother, thus less offensive with less hard glare (which most people subjectively like). But the sound usually also gets smeared, veiled, defocused, rounded, duller, etc. We don't think that you should have to suffer a loss of true musical information in order to get more musically comfortable sound.

We are satisfied only if the sonic change is wholly for the better. Chiefly, we expect a sound improvement product to at least preserve all the information that we heard before, and preferably reveal even more true musical information than we heard before. Then, if the product also makes the sound more musically natural, or provides other objective sonic benefits, then that counts as a further plus. These are simple criteria that we expect and demand, but few products make the grade. Yes, virtually all these products do make a sonic difference, but it takes wishful thinking or a blind ear to ignore the downside of the sonic changes they wreak.

Audio Desk CD Edge Trimmer

Fortunately, there are a few winners that truly accomplish small miracles with the CDs in your library. The Audio Desk edge trimmer is a hands down winner. It actually reveals even more of music's subtle inner detail, and over the whole spectrum (not just in one favored frequency band). The CD medium is not noted for being very transparently revealing of subtle inner detail, taking a seat behind vinyl LPs and the new high resolution digital formats. So it is a major accomplishment for an enhancement product to improve the sound of CD in one of its weakest areas. This makes your large CD collection all the more musically treasurable, and lessens any impetus to duplicate the same title on an expensive high resolution format (and of course high resolution titles don't begin to approach the breadth and depth available on CD).

The Audio Desk edge trimmer also will please music lovers who find that CDs often sound too hard and glary, especially in the upper frequencies. Treating a CD with the Audio Desk makes the midranges and trebles noticeably smoother. It is noteworthy that this smoother sound does not carry with it the usual loss of information and veiling we find in most other products that smooth down the sound. This in itself is a sign that the Audio Desk treatment is doing the music smoothing right, by getting rid of the glare - in contrast to the usual way other products do it wrong, by covering up the glare with Vaseline over the camera lens, thus also covering up details and veiling true musical information in their attempt at smoothing.

Interestingly, we also hear the Audio Desk improving music's bass. Bass becomes better defined, more tuneful, and less boomy.

What technically does treatment with the Audio Desk edge trimmer accomplish? First, it makes each CD truer and better dynamically balanced. As you know, each CD is a stamped, molded piece of plastic. So its edge has significant irregularities. This means that each CD is out of round and not dynamically balanced. If you drove your car with its wheels and tires out of round and out of balance, you'd experience horrendous thumping and shimmying. A CD rotates pretty fast, so it too experiences considerable wobbling and shimmying forces from its being out of round and out of balance. Furthermore, it is the outer edge of the CD where the irregularities are the worst from the molding process, and this is precisely the worst location for such irregularities to be. Irregularities way out at the edge of any rotating system have the maximum, worst adverse effect, because they have the maximum moment arm or angular momentum out at the edge.

A major irregularity at one point of the circumferential edge would cause the disc to wobble or shimmy once per revolution. This in turn would place sudden great demands on the rotational servo and tracking servo (perhaps also the focusing servo), once per revolution. And this in turn would mean that these servos would draw a large burst of current once per revolution. When servos draw a burst of current, the voltage or current available to sensitive circuitry elsewhere in your CD player might drop, and this drop might either directly cause distortion (say by changing operating points) or might indirectly cause distortion by modulating the signal decoding process at some point. Thus, the music might suffer distortion modulated at a once per revolution frequency. The CD spins at a rate from 200 to 500 rpm, which is equivalent to 3 to 8 Hz. Now, 3 to 8 Hz is obviously a very low

bass frequency, and it would strongly modulate music's bass, from 20 Hz to 100 Hz, probably making it sound less defined, more boomy, less tuneful. We normally think of digital as having problems at only very high frequencies, and digital is often touted as having supposedly perfect bass down to DC. But here we can see that the bass quality from CD could be degraded significantly, by something so simple as a once per revolution irregularity at the rim of a pressed and molded CD. And if you could remove this irregularity by trimming the disc edge to be more precisely uniform, then music's bass quality should improve, since you could then hear the true bass sound of the original music, without the contamination of modulation distortion. That's just what the Audio Desk edge trimmer does, and an improvement in music's bass is exactly what we heard as a result.

Then there are also many smaller irregularities around the periphery of a disc stamped in a mold. Since there are more than one of these irregularities per revolution, the complex wobbling, shimmying, and vibration they induce in the rotating CD are naturally spread among many frequencies, all higher than the 3 to 8 Hz that a once per revolution irregularity induced. And what do we find in the many frequencies above 8 Hz? Why, the whole musical spectrum of course. Thus, these many smaller irregularities cause the servos to work overtime and draw distortion inducing bursts of current at frequencies throughout the musical spectrum. These many small irregularities cause the whole musical spectrum to sound degraded, due to the modulating distortions being at higher frequencies. These degradations might make the music sound more veiled and smeared, less transparent, with some bright or glary ugliness - all due to distortion sidebands, which add bright or glary byproducts, and temporally smear music's details, and fill up what should be intertransient silence with time smeared distortion energy, and thereby also veil and block music's subtle inner details. If you could remove these many smaller irregularities by trimming the disc edge to be more precisely uniform, then these degradations should disappear, and you should hear more of music's subtle inner details, with smoother sound, throughout the spectrum. That's just what the Audio Desk edge trimmer does, and these are exactly the sonic improvements we heard as a result.

When the Audio Desk unit trims the edge of each CD, it creates a clean, uniform new edge. And it deliberately creates that edge at a special 38 degree angle. The intent is to direct and control the spurious portion of light from the laser that gets scattered into the body of the disc (as opposed to that portion of laser light that is directly reflected back to the transport's photodetector). Some of this light scatter probably originates from the complex interference that occurs when the laser reads a pit (as opposed to the land between pits). This scatter, if uncontrolled, could adversely contribute to optical noise picked up by the photodetector, and thereby produce a poorer quality eye pattern with a poorer signal to noise ratio, thereby degrading the sound of your music.

The Audio Desk edge trimmer is sturdy and well engineered. It is a bit noisy and messy to use, but you only have to do it once for each CD. The unit retails for $495, which is well worth the sonic improvement it gives you, especially if you have a large CD collection to amortize the cost over (if you own only a few CDs, some audio dealers who own this machine will trim your CDs as a service for a nominal fee). A standard cutting blade for this machine can trim about 400 CDs (replacement blades cost $35), and a special hardened blade is also available that should last for about 2000 CDs (these hardened replacement blades cost $90, or just 4.5 cents per CD).

Furutech RD-1 CD Demagnetizer

The Furutech CD demagnetizer might at first seem to be at the outer fringes of the improbable. Demagnetizing tape heads makes sense for two reasons: tape heads are made from permeable material, and the tape reading process depends on sensing magnetism. But neither of these reasons applies to CDs. CDs seemingly do not contain any permeable material that could become magnetized (neither aluminum nor plastic is permeable), and furthermore the CD reading process does not involve reading a magnetic field. So when we conducted our A-B before vs. after comparisons, we were admittedly biased. We did not believe that we would hear any sonic differences, nor any sonic improvement worth writing about. But hearing is believing. The Furutech is another winner that does make a sonic difference, and it is one of that very rare breed where the difference is entirely for the better.

Like any demagnetizer, the Furutech is intended to be used repeatedly and regularly, perhaps every few plays of each CD. Operation is very simple and automatic. You simply press the button and wait 10 seconds for the light to go out, indicating that the Furutech has completed its cycle. It automatically performs the task of gradually decreasing its demagnetizing field strength during this cycle, so you don't even have to bother with the manual chore of gradually withdrawing your CD away from the magnetic field (as you must do with old fashioned tape demagnetizers).

The Furutech makes your CDs sound more like the new high resolution digital formats. Music's trebles become faster, more extended, airier, and more open. There's a blacker background between musical notes, with better intertransient silence. You can hear more of music's subtle inner details. The natural hall ambience and decay captured by the recording is revealed much better. And music sounds a little more natural, with a little less of the upper midrange glare that characterizes many CDs.

That's a mighty impressive list of sonic accomplishments for a treatment that shouldn't make any difference. So let's investigate.

If we look at the Furutech's sonic accomplishments just above, we might notice that they could all be explained by one factor. If the Furutech somehow reduced the level of contaminating noise, then all the above sonic benefits might follow. Noise contamination certainly fills in what should be a silent black background between musical notes. This degrades intertransient silence, and also veils or blocks music's subtler inner details, which are audible immediately after and between music's stronger transients only if there is a silent background between these stronger transients. Likewise, contaminating noise would obscure and degrade subtle information like hall ambience and decay, which again are audible after and between musical transients only if there is a silent background. Finally, contaminating noise also smears and effectively dulls musical information, acting as a temporally lingering shadow that defocuses music's sharper edges. This is especially destructive of fast treble information, because treble information is by definition more transitory, with sharper edges, so it is more harmed by smearing, lingering shadows, and defocusing than are music's lower frequencies, which have rounder edged waveform profiles, and which tend to be more repetitive.

If CD treatment with the Furutech were somehow reducing some contaminating noise, then we would expect to hear these aforementioned problems reduced - we would expect to hear exactly those sonic benefits which we in fact do hear.

Now, how on earth might the Furutech somehow reduce contaminating noise? What is there in a CD that might cause contaminating noise, and that might need demagnetizing? And how does a CD get re-magnetized by being played, such that it benefits from further demagnetizing after a few plays?

The Furutech people have two simple answers. Ink and impurities. The whole surface of a CD is covered with ink, to make up the printed label. These inks contain pigments, some of which are ferrous, hence permeable. The Furutech people also suggest that the aluminum in the reflective layer might well contain impurities, including iron.

Now, the CD rotates pretty fast (200 to 500 rpm), and any ferrous material will gradually become slightly magnetized over time if it is rapidly moving in a magnetic field (the earth's magnetic field will do, but there are doubtless other magnetic fields as well within a CD player). All right, so we have a CD with some slightly magnetized pieces of ink, spinning around inside your CD player. How does that cause contaminating noise in your music?

Let's assume that the brown pigment in brown ink is ferrous, and let's assume that some small lettering on the CD label is printed in brown ink. Let's assume that there are about 50 letters in the small lettering, which means that there are about 100 vertical ferrous bar magnets (for example, the letter H has two vertical bars), rotating around with the CD. These rotating bar magnets are putting an electromagnetic noise field into the space and air inside your CD player. If the CD is rotating at 8 Hz (480 rpm), and there are 100 discrete bar magnets going around at 8 Hz, then they are putting out noise with a fundamental at 800 Hz, together with all kinds of overtones spread upward throughout the rest of the musical spectrum (if we were to assume the bar magnets were purely rectangular and put out noise that looks like a square wave, there would be overtones at 2400 Hz, 4000 Hz, 5600 Hz, etc.).

You can see that this contaminating noise thrown into the air is rich in high frequency spectral content, so it would be most destructive of music's higher frequencies and of singular, non-repeating musical transients, if it were to somehow interfere with the music signal inside your CD player. And, if a CD treatment like the Furutech could reduce this high frequency contaminating noise, then we would expect to hear the sonic improvements being most dramatic for music's trebles and for its singular transients - which is exactly what we do hear.

Given that this noisy electromagnetic field is radiating into the space and air inside your CD player, how could it come to actually contaminate your music? After all, your music signal is safely traveling inside the conducting wires of the CD player's circuitry, isn't it? So who cares if there's spurious electromagnetic noise in the air outside these wires, right?

Well, it turns out that electromagnetic fields in the space and air just outside your CD player's wiring can also penetrate into that wiring, so if that field comprises contaminating noise, then that noise can add to or interfere with the signals in your CD player's wiring. The analog circuitry in your CD player is certainly vulnerable to signal degradation by interference from noise, but so also is all the digital circuitry in your CD player. Why? First, that so-called digital circuitry is actually analog circuitry, operating with precise thresholds and precise currents, whose level and/or precise timing can be contaminated, degraded, or made less determinate by noise. Second, it is now widely recognized that merely adding noise to a digital signal in your CD player can worsen jitter (by making thresholds more temporally indeterminate), which in turn worsens distortion of your music when that timing indeterminacy reaches your DAC chip. If the interfering noise has high frequency content, then this can cause high frequency jitter, which is especially destructive of music's higher frequencies, causing smearing kinds of distortion (from FM distortion sidebands spread over a wide and high frequency range).

Furthermore, it turns out that the desired signals running around in the wiring of your CD player are not really traveling inside the wires, but instead are actually traveling as electromagnetic fields in the space and air outside those wires - in the very same space and air also occupied by the noisy electromagnetic field from those spinning magnets on the CD. Since the desired CD player signals, representing your music, and the noise from the spinning CD magnets are both mixing it up in the

same space and air, naturally there is cross contamination.

Similar considerations would apply to any ferrous impurities in the aluminum deposited on the CD as its reflective layer.

A simple 10 second demagnetization with the Furutech would erase all these tiny magnets, and thereby would eliminate this source of contaminating noise, providing just the kind of sonic benefits we in fact do hear. Then later, after a given demagnetized CD has rotated fast about 75,000 times, it stands to reason that the ferrous particles in the label and/or in the aluminum might have become magnetized once again, so it would be beneficial to treat that CD to another simple 10 second demagnetization by the Furutech. Incidentally, note that in just 3 plays of a long (74 minute) CD, it rotates fast about 75,000 times. Thus, remagnetization and sonic degradation could begin again sooner than you would suspect. Since it is a pain to keep track of how many times you have played each CD since its last demagnetization, it might be easier to simply demagnetize every CD before each critical listening session, and don't bother before casual listening sessions.

In sum, there is a plausible hypothesis explaining how the Furutech demagnetizer achieves its sonic benefits, and indeed just the kind of sonic benefits that we in fact hear (this predictability and corroboration lends additional credence to the hypothesis). Of course, the most important proof of the pudding is in the listening. The sonic improvements you'll gain from using the Furutech on your CD library clearly make it a winning CD treatment to invest in.

(Continued on page 54)